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Comparative study on the use of virtual reality technology as a treatment for claustrophobia

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***Abstract*– This article aims to test whether the use of technology called virtual reality influences the treatment for people with claustrophobia in which, it seeks to replace the methods to solve this phobia with the use of technologies making the monitoring of these people easier and manageable, for this, indicators were raised with respect to time, recovery, satisfaction and reduction of failed treatments in patients who were divided into two groups based on the fact that one group applied this technology as a treatment, and another group who did not apply the treatment with virtual reality, giving as a result that the use of this technology influences as a solution for the treatment of people who suffer from this phobia regarding the indicators already mentioned in the research.**

Keywords—Comparative study, virtual reality, treatment for claustrophobia.

I. Introduction

Currently the use of information technologies has served as a solution to many of the unknowns based on different branches, either to provide food services, apply the use of social networks, sports, public safety, among others, regarding the health sector has shown progress on learning the behavior of people or to apply the service of therapy remotely and even as a response to the treatment of phobias by applying the use of virtual reality in which is mentioned in this research called claustrophobia, in which the use of this technology is used to treat people suffering from phobias and anxiety problems as a method of rehabilitation for these ailments that may arise for various reasons during the life of these people [1].

The main cause of claustrophobia is formed after several events occurred in childhood or adolescence in which many of these people suffered traumatic events causing these people to present an unpleasant or depressing behavior because of staying in closed places or spaces, Therefore, the most appropriate treatment to deal with such phobia or other cases is by means of exposure therapy, which should submit the patient, who suffers from this phobia, to a closed environment, whether this method is applied in reality or in the imagination of the patient [2].

This problem originates at some point in the life of a person in which usually occurs some trauma that causes that internal fear is marked during his life so that, this is a great difficulty for those who live in places where crowds occur or whose workplaces at certain times usually concur an estimated number of people causing the aforementioned enclosed spaces, also, another of the causes that lead to the suffering from claustrophobia was due during the period of pandemic COVID-19, in which, during a long period of confinement, among testimonies of therapists and patients in hospitals and clinics, staying inside their homes to prevent contagion, many of them because of the closed spaces and not being able to go out anywhere for the reasons already explained, applying in some cases remote work, many people began to suffer various anxiety problems that led them to suffer from stress, hatred, fears and in the worst cases, suffer from claustrophobia due to the fact that they had to remain in their homes until further notice [3].

Therefore, applying the use of virtual reality facilitates the treatment of the patient against claustrophobia since this system designs an environment based on projected areas within the tool simulating a created world which can be viewed through virtual reality glasses that aims to create a world in which the user can interact within that environment performing different needs based on their tastes and requirements [4].

Based on this, it can be indicated that the use of this technology for the treatment of claustrophobia is of great utility given that the use of a world created to carry out the method of exposure therapy where a simulation can be performed in which the patient enters an enclosed area or space that helps with the original trauma of the patient, Since fear is produced as a response to a threat detected by the person who is defensive, this can be misinterpreted if there is no danger in itself, however, the person can interpret it as a possible threat by performing defensive behaviors previously mentioned [5].

In this context, this article aims to conduct a comparative study on the use of virtual reality as a treatment for claustrophobia in which the results of the use of the tool to reduce this fear in people will be shown, it is also intended to evaluate the time of treatment for these people suffering from claustrophobia, verify how many of these patients recovered successfully, the satisfaction of these people regarding the treatment given, and reducing the number of people who were

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unsuccessful during treatment, Therefore, during the development of the research a review of the effects of the application of this technology will be made gradually providing a better quality of life to people with this problem, also, the psychologist who participates in the experiment can monitor the progress of the patient in the virtual environment which will have a better management of what can be treated unlike traditional methods to help the person suffering from claustrophobia.

II. Literature review: virtual reality and claustrophobia

A. Previous studies

A systematic review on immersive virtual reality in health care, which delved into how medical professionals can currently employ the use of technologies to immerse their patients in environments to achieve the visualization of a specific behavior or reaction. The objective of the research was to identify which applications of immersive virtual reality focused on medical patients for the treatment of serious diseases, and to identify the technical characteristics of the IVRs used. Fifty-eight researches in nineteen countries were taken into account for the result of the information, where it was found that immersive virtual reality was applied in five main areas in medicine; neurology and development with a total of ten researches identified, pain reduction through distraction where twenty researches were found, exposure therapy for the treatment of phobias with nine researches reviewed, psychological applications with fourteen researches, and other five researches with different topics; As a result of the review it was identified that twenty-nine were focused on exploring the feasibility of systems and the general acceptance of the users while the remaining focused on efficacy studies for the verification of the clinical effect. It was concluded that immersive virtual reality has a bright future in relation to healthcare, both research and commercially, however, because the feasibility of the application of these technologies is still being explored, evidence of their efficacy is still under review [6].

For the following research taken into account, a literature review was conducted on the implementation of virtual reality in psychiatry where research information was collected focused on the status of therapies performed with virtual reality in various cases of psychiatry such as anxiety disorder, post-traumatic stress disorder, psychosis, addiction and eating disorder, after the review of the selected researches it was possible to identify that virtual reality presents great promising contributions to the field of mental health of patients, the implementation of these technologies have shown high results compared to traditional therapeutic methods and provided the possibility of exploring new approaches to treatment that were previously difficult to apply, however, it is a priority to demonstrate to what extent it is effective, safe or harmful therapies by virtual reality compared to traditional methods. The research concludes with the application of virtual reality as a promising tool for human medicine, also in the accessibility of these technologies and how prices are becoming more accessible, in addition to taking into account the availability of having therapeutic sessions at home through these devices, however, it is worth mentioning the complications that still present these technologies, such as prices that are still high, the dizziness caused by the devices for the use and effectiveness, so its acceptance as a stable technology as an input should remain under supervision [7].

B. Virtual Reality

It is the formation of computer-developed graphics that consists of a user being inside a virtual world designed so that it has a control and management of the objects that are within that world in which, the person within that reality sees and perceives everything created and implemented within that world where you can perform various actions depending on the needs of the user by computer [8].

In addition, employing the use of virtual reality involves the use of tools or devices that help with the management and control of this system, so, these environments that are created by technological tools, are visualized by users through an electronic device called Virtual Reality glasses, which generate the concept of the person who is within the virtual world and the feeling that in reality if you are in this world with the characteristic that you can interact and perform actions within this reality [9].

Also, it can be said that many users employ the use of virtual reality based on different uses that are mostly implemented in video games, in which, a virtual environment is characterized by the development of simulations and interactions in real time through the use of technological devices that make the user a character within this environment in which today, In addition to the use of the aforementioned virtual reality glasses, the use of controls and sensors are also used, which not only gives the user the possibility of visualizing the virtual world in real time in first person, but also the fact that the person can touch or move objects within the world or simulation, making its use and management more interactive for users [10].

C. Claustrophobia

Claustrophobia to begin with is defined as an anxiety disorder or onset of stress in which, the person suffers from this problem because of being in an enclosed area or space, now well, this disorder does not start with the person already inside this place but rather of the consequences that may occur once inside the danger zone which considers that person [11].

The fear of a person to stay inside these confined spaces can cause various anxiety disorders because of this phobia which includes a disproportionate reaction of fear that causes alterations of the person, i.e., it is possible that the patient in the worst case, present pictures of stress in which the reactions manifested can become as violent as unstable by the fact that this is in the confined space [12].

D. SCRUM framework

SCRUM is characterized both by being an agile methodology and by making the people involved in the research known, making them part of the team, guaranteeing the quality of the results of the research, all processes are managed within the phases of the framework ensuring that each phase presents a deliverable which provides knowledge to the people involved in the project including the SCRUM Master and the Product Owner, also, the times within the methodology can be manageable based on the capabilities of both the team and the requirements proposed by the stakeholders [13].

The SCRUM methodology provides multiple advantages that implies that the project can be adapted as the project develops or if changes are required in the product to be developed, on the other hand, the use of Sprint to record the progress made by the SCRUM team, as well as the use of tools that help to generate the reports due to the project stakeholders which are called deliverables as previously mentioned, serve to keep abreast of how the project is developing over time through meetings with the SCRUM Master and the other users who validate whether the work is compliant or not [14].

III. Methodology

A. Type of research applied

It is related to the basic type of research with the difference that a solution to a problem is made from the theory already raised, that is, a finding is made that represents in part the solution of a research from the problematic reality [15], therefore, the present research was used the applied type since from the theory raised on the use of virtual reality technology in relation to the treatment against claustrophobia, the solutions will be made before the changes in people who handle the tool to solve the problem from which they suffer.

B. Pure experimental design

This design involves the inclusion of groups to compare which manipulates one of the variables in which the use of tests is applied before and after implementing the solution to a problem, however, there are cases in which the experimental design does not require a pre-test as opposed to the post-test which of course is mandatory to establish what were the effects of the solution to the problem [16], Therefore, the present research will use the experimental design since, based on the results, it will be demonstrated whether the use of this technology implies a positive effect for people who suffer from this phobia.

C. Quantitative approach

This approach employs estimations on quantities based on events occurring in an area in question where to check the results of the effects within this scenario a hypothesis is posed which can be countered or accepted depending on the answer obtained in an investigation in which, within the results of a quantitative research, the use of numbers is employed to obtain such estimates thus checking whether the hypotheses raised are in accordance or rejected [16], so, the present research presents a quantitative approach given that, based on the hypotheses raised during the research is that it will be checked whether the use of virtual reality provides a solution as a treatment against claustrophobia.

D. Procedures

In this article, the following hypotheses were proposed: the use of virtual reality reduces the treatment time of these people, the percentage of recovered patients increases, as well as the satisfaction of patients with this treatment and the reduction of patients who experienced this phobia again, in addition, the population and sample of the research were proposed. All of this can be seen on Table I.

TABLE I
POPULATION AND SAMPLE TABLE

Name	Descripción
Universe	Patients undergoing treatment for claustrophobia, since the estimated amount is unknown: N = Undetermined
Sample	The following sample will be considered for the research: N = 30
Sampling type	Simple random probability sampling

Simple random sampling employs a selection of the population that implies that all members of the population are relevant in that they have the same probability of being selected within the sample to start with the research and corroborate the results of this [17], therefore, simple random probability sampling was used since the research takes into account the group of people who suffer from claustrophobia, The type of simple random probability sampling was used since the research takes into account the group of people who suffer from claustrophobia, for this, it was distributed into two groups, patients to whom the traditional treatment will be applied, that is, the virtual reality technology will not be used and patients who if this technology is applied as a treatment for this phobia.

IV. Results

The values obtained during the post-test of the technological tool on the four indicators in which two groups will be considered, those who will apply the virtual reality treatment (Ge), and those who will not apply the treatment implemented virtual reality (Gc). The results are displayed in different tables, being Table II the one containing the results of the first indicator, Table III the one containing the results of the second indicator, Table IV the results with the third indicator and Table V the one contained the results with the fourth indicator

TABLE II
TABLE OF RESULTS OF THE FIRST INDICATOR

KPI 1: TIME TO PERFORM THE TREATMENT (HOURS)		
N°	Post-test Gc	Post-test Ge
1	15	13
2	12	10
3	13	12
4	16	9
5	12	10
6	15	8
7	11	10
8	10	9
9	12	8
10	16	12
11	14	8
12	10	10
13	8	6
14	13	11
15	12	10
16	13	10
17	15	9
18	9	7
19	14	8
20	16	11
21	12	8
22	13	10
23	15	9
24	12	11
25	15	7
26	14	12
27	13	8
28	14	9
29	16	13
30	11	7

TABLE III
TABLE OF RESULTS OF THE SECOND INDICATOR

KPI 2: RECOVERY RATE **(%)**		
N°	Post-test Gc	Post-test Ge
1	75	88
2	64	72
3	65	83
4	88	90
5	81	85
6	80	82
7	60	75
8	62	71
9	83	87
10	73	87
11	71	78
12	81	83
13	66	79
14	70	76
15	85	88
16	84	90
17	66	73
18	65	69
19	82	83
20	75	71
21	81	76
22	72	75
23	62	78
24	74	81
25	63	85
26	78	79
27	84	89
28	69	75
29	87	90
30	75	82

TABLE IV
TABLE OF THE RESULTS OF THE THIRD INDICATOR

N°	Post-test Gc	Post-test Ge
1	Totally agree (4)	Totally agree (5)
2	Neutral (3)	Agreed (4)
3	Totally disagree (1)	Neutral (3)
4	Disagree (2)	Agreed (4)
5	Totally disagree (1)	Disagree (2)
6	Agreed (4)	Agreed (4)
7	Disagree (2)	Neutral (3)
8	Disagree (2)	Totally disagree (1)
9	Neutral (3)	Neutral (3)
10	Totally disagree (1)	Disagree (2)
11	Totally disagree (1)	Neutral (3)

12	Agreed (4)	Agreed (4)
13	Neutral (3)	Agreed (4)
14	Disagree (2)	Agreed (4)
15	Neutral (3)	Agreed (4)
16	Agreed (4)	Totally agree (5)
17	Neutral (3)	Agreed (4)
18	Neutral (3)	Agreed (4)
19	Agreed (4)	Totally agree (5)
20	Agreed (4)	Neutral (3)
21	Disagree (2)	Neutral (3)
22	Totally disagree (1)	Disagree (2)
23	Totally disagree (1)	Agreed (4)
24	Totally disagree (1)	Disagree (2)
25	Disagree (2)	Neutral (3)
26	Totally disagree (1)	Agreed (4)
27	Neutral (3)	Agreed (4)
28	Totally disagree (1)	Neutral (3)
29	Disagree (2)	Disagree (2)
30	Neutral (3)	Totally agree (5)

TABLE V
TABLE OF THE RESULTS OF THE FOURTH INDICATOR

KPI 4: Relapse rate **(%)**		
N°	Post-test Gc	Post-test Ge
1	12	10
2	15	13
3	18	17
4	16	15
5	19	12
6	12	11
7	15	12
8	19	14
9	18	11
10	16	14
11	15	13
12	18	16
13	17	15
14	16	13
15	14	11
16	13	10
17	18	15
18	15	12
19	19	16
20	17	13
21	20	16
22	16	12
23	13	10
24	18	14
25	15	13
26	16	12
27	17	14
28	12	11
29	14	12
30	16	11

Once the test data for each indicator has been collected, the average for each indicator is shown below on Table VI.

TABLE VI
TABLE OF AVERAGE POST-TEST INDICATORS OF GC AND GE

Indicator	**Post-test Gc (half)**	**Post-test Ge (half)**	**Commentary**
KPI 1: Time to perform treatment	13.03 h	9.50 h	---
KPI 2: Percentage of recovery	74.03%	80.67%	---
KPI 3: Patient satisfaction	---	---	Qualitative Indicator
KPI 4: Relapse rate	15.97%	12.93%	---

Once the data for the average of three indicators was obtained, the normality test was verified for both samples showing the following result on Fig. 1.

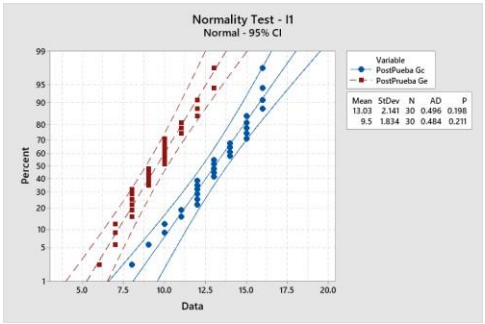

Fig. 1 Normality test of the first indicator

The graph indicates that in the posttest of the Gc and Ge, show that p(0.198 and 0.221), being greater than α(0.05), so the values of the indicator possess normal behavior.

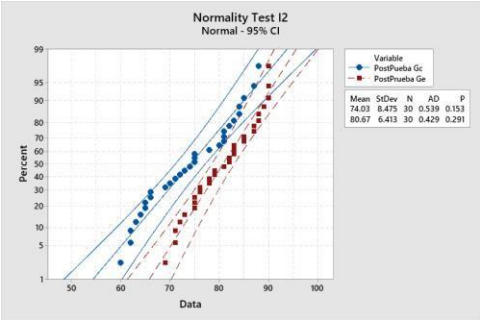

Fig. 2 Normality test of the second indicator

As shown in Fig. 2, the posttest of the Gc and Ge of the present indicator presents that p(0.153 and 0.291), is greater than the normal α(0.05), showing normal behavior.

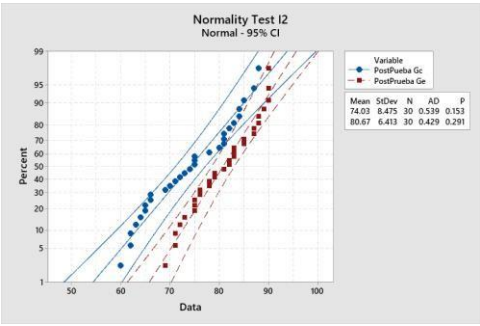

Fig. 3 Normality test of the third indicator

The Fig. 3 based on the fourth indicator shows that in the post-test of Gc and Ge show a normality of p(0.265 and 0.150), being greater than α(0.05), implying that the indicator has a normal behavior.

Next, as the satisfaction indicator is made by means of surveys, it is not considered to perform a normality test for this indicator, however, it is considered to make a comparison between the group which did not apply the use of the technological tool with the group who did apply the use of the tool as a treatment for claustrophobia in which the following is shown in Fig. 4.

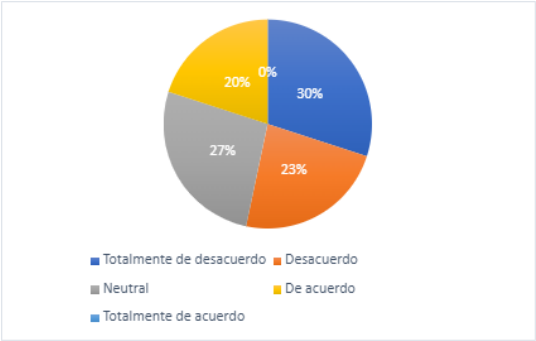

Fig. 4 Graph of the Gc posttest of the third indicator

As a result of the data collection, it can be observed from Fig. 4 that of the patients who received a traditional therapeutic session, 30% categorized satisfaction as in total disagreement, 23% identified themselves as in disagreement, 27% identified themselves as neutral, 20% stated that they agreed, while 0% were in total agreement with being satisfied with the traditional sessions, i.e. 46.67% of the observations are positive, while the remaining 53.33% are negative.

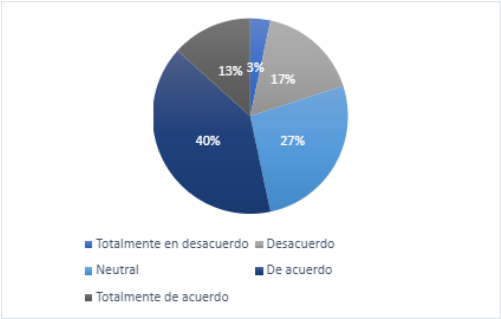

Fig. 5 Graph of the Ge posttest of the third indicator

On the other hand, the results seen in Fig. 5 of the evaluations of the patients who received therapy applying virtual reality show that 3% categorized satisfaction as in total disagreement, 17% identified themselves as in disagreement, 27% identified themselves as neutral, 40% stated that they agreed, while 13% were in total agreement with being satisfied with the traditional sessions, i.e. 80% of the observations are positive, while the remaining 20% are negative.

Then, the hypotheses are contrasted with the results obtained from the four indicators, then, the contrastation is shown for the first hypothesis in which the use of virtual reality reduces the treatment times of people suffering from claustrophobia, this is checked if the population mean based on the treatment using virtual reality is lower than the population mean of those who did not implement virtual reality, so the use of t-test for the means of the two samples is applied. This is shown in Fig. 6.

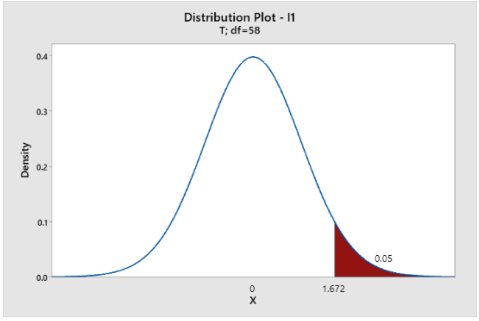

Fig. 6 Decision criteria graph of the first indicator

On the other hand, the results of the evaluations of the patients who received therapy applying virtual reality show that 3% categorized satisfaction as in total disagreement, 17% identified themselves as in disagreement.

TABLE VII
T-TEST FOR TWO-SAMPLE MEASURES OF FIRST INDICATOR

	Post-test Gc	Post-test Ge
Half (x)	13.03	9.5
Standard Deviation (S)	2.14	1.83
Remarks (n)	30	30
Hypothetical difference of means	3.533	
t calculated: tc	6.86	
p-value (a queue)	0.000	
Critical value of tα/2 (a queue): tt	1.627	

Based on the data obtained from the tests, it is shown that the p-value obtained is 0 being less than the normality of α(0.05), therefore, the hypothesis raised of the reduction of the times in the treatment of the person with claustrophobia is accepted.

In the case of the second indicator in which it is mentioned about the percentage of recovery, based on the null hypothesis indicating that the use of this technology decreases the percentage of patients recovered from this phobia, for this, just as the previous case, checking the means of each sample and implementing the t-test for the contrastation of the second hypothesis as seen in Fig. 7.

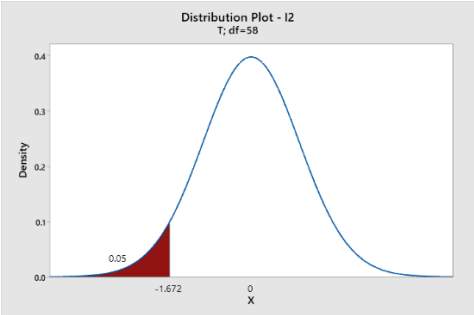

Fig. 7 Decision criteria graph of the second indicator

TABLE VIII
T-TEST FOR TWO-SAMPLE MEASURES OF SECOND INDICATOR

	Post-test Gc	Post-test Ge
Half (x)	74.03	80.67
Standard Deviation (S)	8.48	6.41
Remarks (n)	30	30
Hypothetical difference of means	-6.63	
t calculated: tc	-3.42	
p-value (a queue)	0.001	
Critical value of tα/2 (a queue): tt	-1.627	

Based on the data obtained from the tests, it is shown in Table VIII that the p-value obtained is 0.001 being less than the normality of α(0.05), therefore, the hypothesis of the increase in the percentage of recovered persons is accepted.

In the case of the third indicator, the nonparametric Mann-Whitney test is applied since this indicator deals with patient satisfaction with the treatment by means of the two samples in which, in order to validate the hypothesis on the increase in patient satisfaction with the treatment, it must be verified whether the population mean of Ge is greater than the population mean of Gc, which is shown as follows.

Method

η_1: median of PostPueba Gc
η_2: median of PostPrueba Ge
Difference: $\eta_1 - \eta_2$

Descriptive Statistics

Sample	N	Median
PostPueba Gc	30	2
PostPrueba Ge	30	4

Estimation for Difference

Difference	Upper Bound for Difference	Achieved Confidence
-1	-1	95.04%

Test

Null hypothesis	$H_0: \eta_1 - \eta_2 = 0$
Alternative hypothesis	$H_1: \eta_1 - \eta_2 < 0$

Method	W-Value	P-Value
Not adjusted for ties	694.00	0.001
Adjusted for ties	694.00	0.000

Fig. 8 Mann-Whitney U-test for two-sample means of the third indicator

Based on the results obtained in the test, it is shown that the p-value of both samples is 0.001 and 0 respectively, being less than the normal α(0.05), therefore, the hypothesis that the use of this technology increases the satisfaction of patients by the treatment given in virtual reality is accepted.

Finally, in the fourth hypothesis which indicates that the use of this technological tool reduces the percentage of patients who returned to have the problem of claustrophobia in which, both samples mentioned previously are taken into account, for this the use of the t-test is employed verifying the means of the two samples in which, the following is shown.

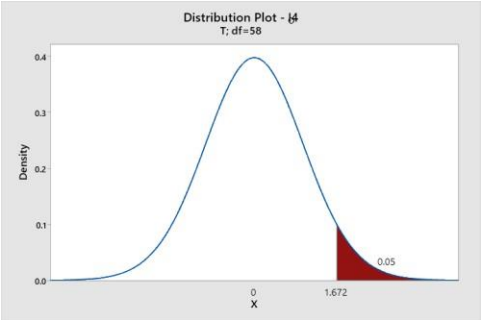

Fig. 9 Decision criteria graph of the fourth indicator

TABLE IX
T-TEST FOR TWO-SAMPLE MEASURES OF FIRST INDICATOR

	Post-test Gc	Post-test Ge
Half (x)	15.97	12.93
Standard Deviation (S)	2.24	1.96
Remarks (n)	30	30
Hypothetical difference of means	3.033	
t calculated: tc	5.58	
p-value (a queue)	0.000	
Critical value of tα/2 (a queue): tt	1.627	

Based on the data obtained from the tests, it is shown that the p-value obtained is 0 being less than the normality of α(0.05), therefore, the hypothesis put forward of the reduction in the percentage of patients who suffered from this phobia again is accepted.

V. CONCLUSION

It is proved that having used virtual reality applying Scrum, improves the treatment for claustrophobic people in the center of integral art and therapies in psychology Artiteps. It is observed that, having used virtual reality applying Scrum, reduces the treatment time for claustrophobic people. It is noted that the use of virtual reality applying Scrum increases the percentage of recovered patients. The use of virtual reality applying Scrum increases the level of patient satisfaction. It is evident that the use of virtual reality applying Scrum reduces the percentage of relapsed patients.

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